

ART. XIII.—*The Leaf of Grewia polygama and its Tannin Content*

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(Communicated by Professor A. J. Ewart.)

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Dried leaves of *Grewia polygama*, which belongs to the Natural Order Tiliaceae, were sent down by Captain Bishop, Veterinary Surgeon at Darwin. A decoction of the leaves is considered, throughout the Northern Territory and Queensland, to be an admirable bushman's remedy for cases of diarrhoea and dysentery, and *Grewia polygama* is recorded in Bailey's "Queensland Plants" as a "valuable remedy" for dysentery.

The decoction is made by pouring boiling water on to the leaves. Decoctions made in this way in the laboratory showed that quantities of a mucilaginous material, which gathered in the form of a cloudy precipitate, were present; also, judging by colour and taste, tannins. The mucilaginous material gave a stringy precipitate with alcohol, and could thus be isolated from the decoction. It was dissolved in weak alkali, and gave a positive Fehling's reaction. The positive furfural reaction and colour with the orcinol test proved that it is a pentose. The tannin is readily soluble, even in cold water. The test with ferric acetate showed a green colour, indicating the presence of pyrocatechol tannins, but further work was sufficient to show that the solution probably contains a mixture of tannins.

Several estimations of the percentage of tannin present were made by the Lowenthal-Schroeder method, and by Proctor's modification of this method (1). This depends on the reducing power of the tannin, and as this varies for each tannin, the method cannot give an exact result, but since the amount of tannin in the leaves varies according to the time of the year, and also according to the age of the leaves, an average result is all that can be hoped for.

First the dried leaves were ground up finely in a mincer, a large amount being ground at one time, so that each sample for estimation was taken from a well-mixed supply. It was noted that all the leaves in the quantity sent were mature; no young leaves or buds were present.

The moisture content of a weighed amount of the air-dried leaves (5.157 grams) was determined, and found to be 11.7%. From this, the dry-weight of each sample taken could be calculated. In the Lowenthal and Schroeder method, the use of a solution of indigo-carmin is necessary to control the oxidation of the

tannin by the permanganate, otherwise the oxidation is too slow, and a definite end-point is not reached. The acid solution required by the permanganate oxidation method is supplied by the sulphuric acid in which the indigo-carmin is dissolved.

Since the infusion contains other oxidisable matters besides tannins, it is necessary to separate these and titrate a second time, in order to ascertain the volume of permanganate actually required by the tannin present. This is done by digestion with hide-powder. As the permanganate has to be standardised also, and the amount of permanganate used up by the indigo-carmin solution alone has to be found, there are four titrations required for each estimation, each of which must be repeated more than once.

For each estimation a known weight of leaves is treated with successive quantities of boiling water, sufficient to give a litre of infusion. Preliminary titrations were done to find approximately the weight of leaves which would give an infusion containing 0.4% tannin (the strength recommended for this method).

Estimations showed that only about 4% tannin was present in the particular leaves submitted. In tea leaves, there is often more than 10% tannin present, so that if the tannin is the active principle, in the form of an astringent, as was supposed, it must be a very active form of tannin.

The presence of resorcinol in the decoction is indicated by the positive result of a test on a pine-wood shaving, using the decoction and strong hydrochloric acid. A pale mauve colour was produced: such a test as this cannot be held a proof of its presence, and another specific test for resorcinol which was tried did not give a positive result. If resorcinol is proved to be present, it must be in such minute quantities that its therapeutic value as an antiseptic would be negligible.

Only dried material was available for sectioning. To soften and expand the leaf-tissues, before proceeding to imbed the leaves for sectioning, the quicker method of boiling in water was used, since it was found to give results quite as good as the use of glycerine with long soaking.

Sections of the leaf showed a rather interesting structure. The tannin is apparently not localised in special cells of the leaf. Mucilage-canals traverse the leaf, some running in the parenchymatous tissue below the main vascular bundle, and some near the upper leaf-surface. The upper epidermal layer contains mucilage, the presence of which is brought out very well in sections stained with ruthenium red. These upper epidermal cells are unusually large, and the cuticle is quite thin. The presence of mucilage in the epidermal cells undoubtedly delays transpiration to some extent, and is probably a xerophytic adaptation, although less effective than the formation of a thick cuticle. Cannon, in his paper on the Vegetation of the more arid portions of South Africa (2), refers to this fact.

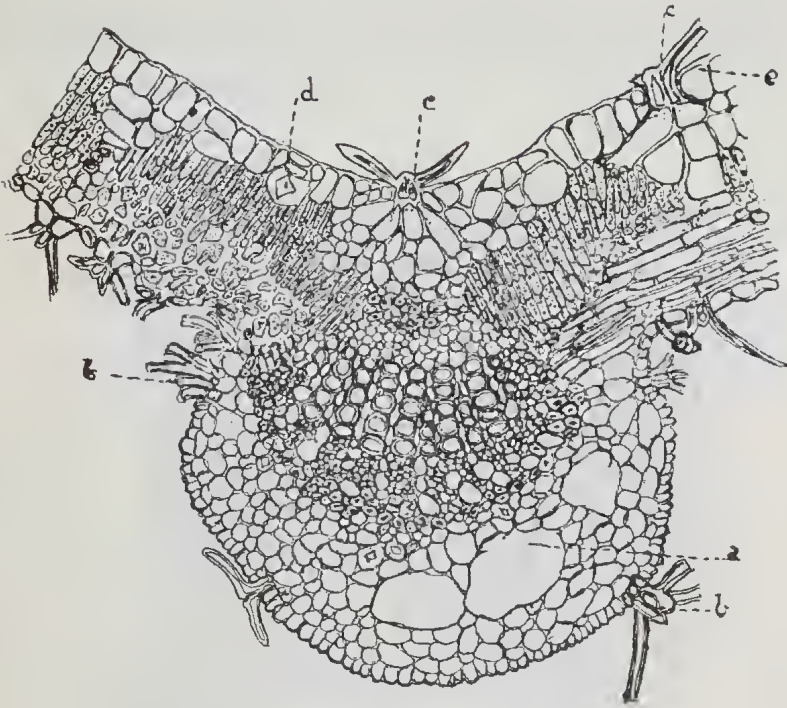


FIG. 1.—Vertical Section of leaf in region of midrib.

- (a) Mucilage canals in parenchyma below vascular strand.
- (b) Hair of lower epidermis.
- (c) Thickly cuticularized hairs of upper epidermis.
- (d) Crystal cell.
- (e) Large epidermal mucilage-cell.

At definite points, just below the upper surface of the lamina, sometimes in the upper epidermis itself, there occur large crystal cells, each containing a single rhomboidal crystal, which, when tested microchemically, proved to be calcium oxalate. A few smaller crystals occur scattered through other parts of the leaf. The large crystals always show noticeably concave faces; this would be due to their formation in a mucilaginous medium, such as is evidently present in the enlarged crystal cells.

There are multifid cuticularised hairs present on both the upper and lower epidermal surfaces, although it is only on the lower epidermis that the hairs form what could be called a covering. Even there, the protruding ribs below the leaf-trace bundles are very sparsely covered with hairs.

On the upper surface the appearance is strongly suggestive of a connection of some kind between the mucilage ducts and the hairs. The ducts appear to run up towards the upper epidermis at the points where the hairs are inserted. The hairs are even more

cuticularised than those on the lower epidermis, and it is hard to understand of what importance such a connection would be, for

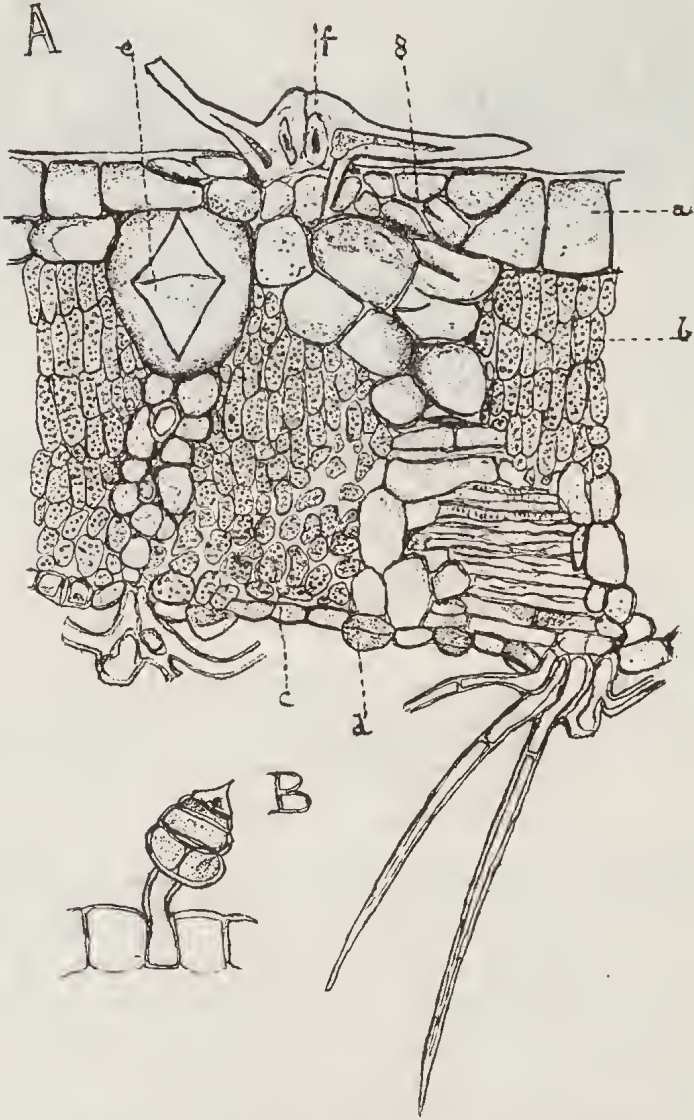


FIG. 2.—A. Vertical section through leaf.  $\times 270$ .

- (a) Large mucilaginous cell of normal epidermis.
  - (b) Palisade layer of mesophyll.
  - (c) Spongy mesophyll.
  - (d) Large stoma, surface view.
  - (e) Crystal of calcium oxalate in enlarged cell with mucilage.
  - (f) Hair of upper epidermis cut vertically.
  - (g) Multiple epidermis at insertion of hair.
- B. Glandular Hair.  $\times 270$

the cell-walls of the hair are cuticularised right down to those cells which form, as it were, the "root" of the hair. Some indication of the same appearance of a connection has also been seen occasionally between hairs of the lower epidermis and mucilage ducts.

Other hairs, shortly stalked, and apparently glandular, occur on both surfaces of the leaf.

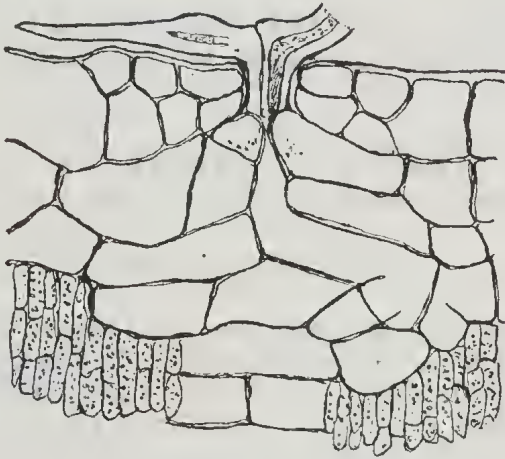


FIG. 3.—Vertical Section through insertion of an upper epidermal hair, to show the typical multiplication of epidermal cells, and the canal-like arrangement of mucilage-containing cells curving up towards the hair.  $\times 270$ .

The stomata present an unusual appearance; they are large, distinctly projecting from the main epidermal level, and stain intensely with ruthenium red. They may occur in rather large and shallow stomatal pits, but are not confined to these.

A remarkable fact about the use of this plant as a medicine is that the aborigines do not know of it, and they are always credited with knowing all the plants in the North that have any important medicinal value.

This investigation has shown no basis for the belief that this decoction is of any special use in cases of dysentery as compared with specifics already known.

#### REFERENCES.

1. A. HARVEY. Practical Leather Chemistry.
2. A. CANNON. Features of the Vegetation of the More Arid Portions of Southern Africa. Published by the *Carnegie Institution of Washington*, Aug., 1924.